

Status of Argos instruments

1- Argos-1 instruments :

There are still two Argos-1 instruments in service.

The first Argos-1 instrument is on-board NOAA-J and continues to function properly (after 13 years in orbit) . It has no redundant receiver.

The other Argos-1 instrument is on-board NOAA-D and has spent 16 years in orbit. It is part of the initial series TN (NOAA-A to G) and was manufactured a long time ago.

Both payloads are operational in regional (real-time in L-band) and in global mode.

NOAA-K to NOAA-N satellites record data onboard and then download them to NOAA's receiving stations at Fairbanks and Wallops Island. Data from NOAA-D and NOAA-J are also recorded onboard, but only retrieved by NOAA when station availability allows.

It can be noted that the HRPT signal of NOAA-L is transmitted in LHCP polarization (instead of RHCP for all other satellites), meaning that some of the HRPT stations cannot receive the real-time signal of this satellite.

2- Argos-2 instruments:

Argos instruments on-board NOAA-K, L, M and N are second generation instruments. They have an increased receiving bandwidth (80 kHz instead of 24 kHz) and an increased telemetry bit rate of 2560 b/s.

The Argos-2 system Capacity is considered to be reached when the probability to receive a single message is 50% . That corresponds to a system occupancy from the satellite = 11 Erlang (computed with 8 processing units over the 80 kHz bandwidth).

Currently, a mean capacity = 2.4 Erlang (2.2 in 2006) is used by the Argos system with peaks = 6 to 7 Erlang above the most crowded areas (South America, West-Europe and South-East Asia).

In average , 0.25 Erlang is used by non environmental applications, that represents in average 10% of the system use but only 2.3% of the Capacity as defined above.

The last Argos-2 instrument has been launched with NOAA-N in May 2005. It functions properly with the exception of the processing unit DRU#8 which has failed immediately after the instrument switch-on.

3- Argos-3 (or A-DCS) instruments:

3.1 Brief description of the instrument.

The first instrument of the third generation Argos-3 (called also A-DCS) has been launched with Metop-A on October 19th, 2006 from Baïkonour.

This instrument has the same receiving bandwidth (80 kHz) for low data rate platforms (@ 400 bps) but adds a new 30 kHz bandwidth for high data rate platforms (@ 4800 bps). The telemetry bit rate is 7440 b/s.

The main improvement of the Argos-3 instrument (in addition of the introduction of the high data rate beacons) is the downlink that allows :

- to acknowledge the uplink messages and then to increase the capacity of the system,
- to transmit broadcasting messages as time or orbit ephemeris in order to activate the platforms emitters only when a satellite is above
- to modulate the length of the messages or the repetition period of the messages according to the user needs.

The Argos system capacity is increased with the introduction of the 30 KHz bandwidth dedicated to high data rate platforms and is now 12 Erlang (11 Erlang for low data rate platforms and 1 Erlang for high data rate platforms).

3.2 Summary of the Metop-A commissioning tests.

The Argos-3 instrument has been switched-on on October 26th .

The commissioning activities have been highly disturbed due to an anomaly concerning the nominal side of the instrument and the corruption of the mission telemetry delivered to the satellite.

The CNES/Thalès expert group report in charge of the anomaly investigation has raised the conclusion that the cause of the anomaly was due (with a very high probability) to a deficiency of the A-DCS FIFO (certainly the mechanism of writing/reading pointers).

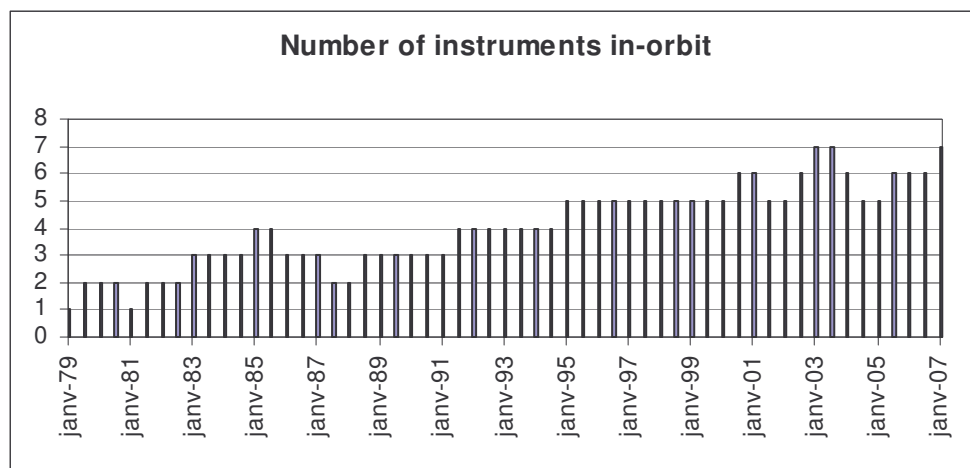
Based on this conclusion, CNES has submitted to EUMETSAT the request to switch-on A-DCS on side 2 . This recommendation has been accepted then the switch-on on side 2 has been performed on March 22nd at 8h32 (UTC).

Currently, the instrument is in a nominal configuration (all software patches have been uploaded and all processing parameters have been tuned).

Some complementary analysis have been performed on several FIFO components (coming from the flight lot). There is no particular deficiency on these components but they have been considered as “sensitive” by the CNES Quality Department and the risk to recover the same anomaly on another instrument exists. Therefore, it has been recommended to perform some long duration tests on the instruments still on ground. Discussions have been initiated with NOAA/NASA and Lockheed Martin (for

NOAA-N') and with Eumetsat and Astrium (for METOP-B and C) in order to organize these long term tests within the satellite integration schedule.
The SARAL instrument, still in CNES, is currently under long-term testing.

There are now six operational payloads in orbit, one of them (Argos-1 instrument on board NOAA-D) should be switched-off by the end of 2007.
Four of them are Argos 2 and one is an Argos-3. These 5 full operational instruments allow a good coverage and availability of the system. Thanks to Argos-3, the downlink service is now operational.



4- System availability

The system has reached a very high level of availability: as supposed that individual satellites IFOV (Instantaneous Filed Of View) are not overlapping, the instantaneous constellation coverage is more than 30% of the earth surface, thanks to the 7 satellites in orbit.

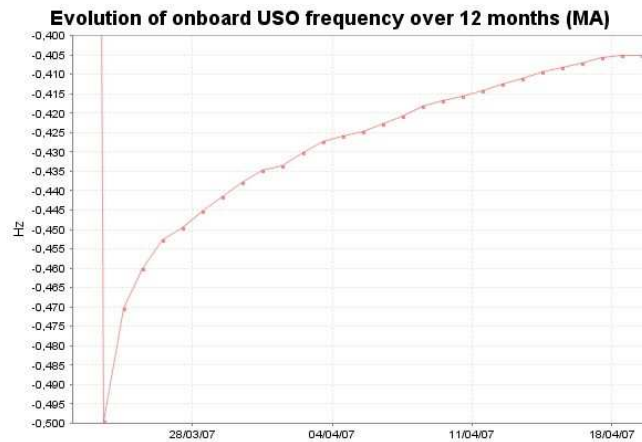
Satellite	Launch date	End	Duration (days)	Duration (year)	Comment
Tiros-N	13/10/1978	27/02/1981	868	2,4	prototype
NOAA-A	27/06/1979	31/03/1987	2834	7,8	
NOAA-B	29/05/1980	29/05/1980	0	0,0	launch failed
NOAA-C	23/06/1981	01/06/1986	1804	4,9	
NOAA-D	14/05/1991	31/05/2007	5861	16,1	3 orbits/day
NOAA-E	28/03/1983	29/12/1985	1007	2,8	proto Advanced Tiros-N
NOAA-F	12/12/1984	13/02/1998	4811	13,2	
NOAA-G	17/09/1986	30/08/2001	5461	15,0	
NOAA-H	24/09/1988	16/06/2004	5744	15,7	stopped on 16/6/04
NOAA-I	09/08/1993	21/08/1993	12	0,0	short-circuit on board
NOAA-J	30/12/1994	23/05/2007	4527	12,4	stopped on 23/05/07
NOAA-K	13/05/1998	31/05/2007	3305	9,1	operational
NOAA-L	21/09/2000	31/05/2007	2443	6,7	operational
NOAA-M	24/06/2002	31/05/2007	1802	4,9	operational
ADEOS II	29/01/2003	25/10/2003	269	0,7	failure of solar panel
NOAA-N	20/05/2005	31/05/2007	741	2,0	operational
METOP-A	19/10/2006	31/05/2007	224	0,6	IOC (Initial Operation Capability)
Total			41489	113,7	

We are currently in the 113th year of cumulated lifetime with Argos onboard payloads without any Argos failure.

5- USO monitoring

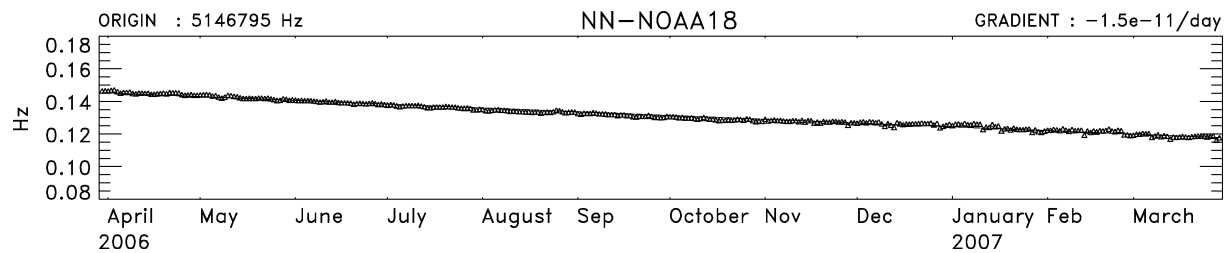
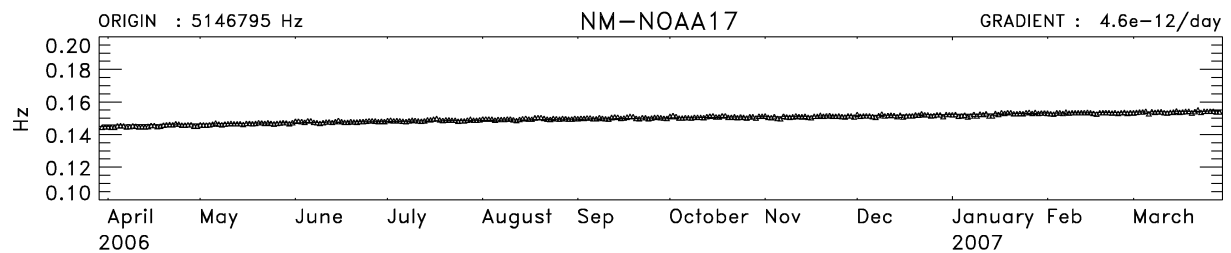
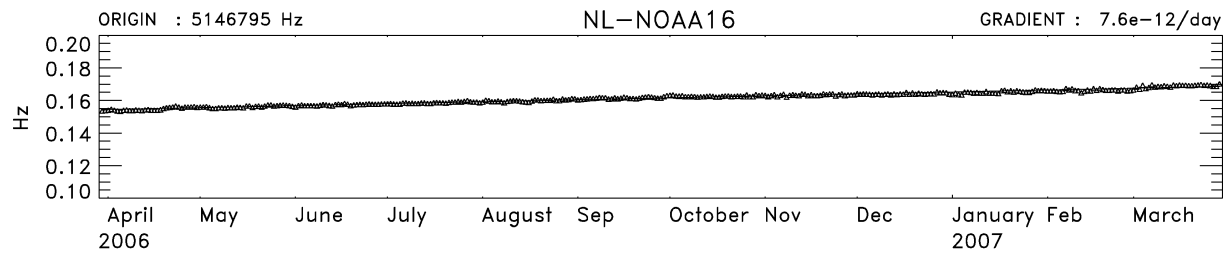
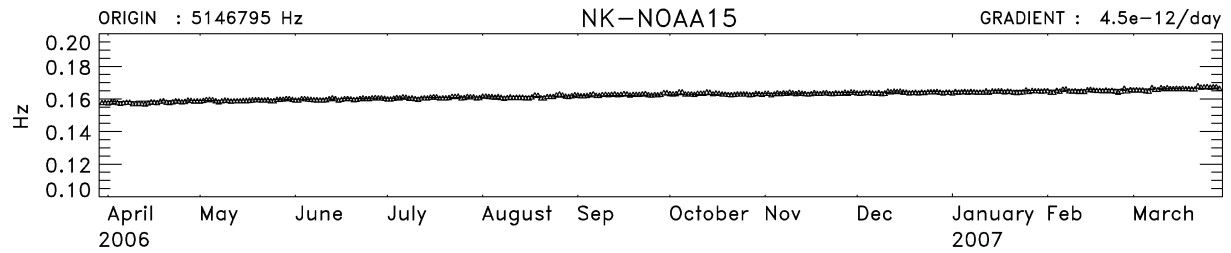
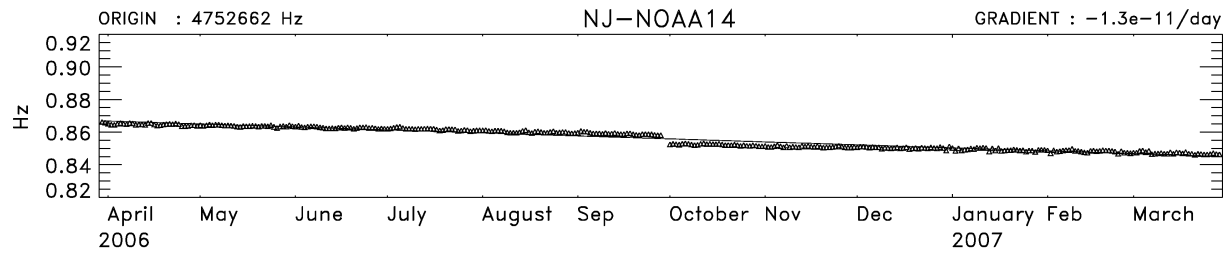
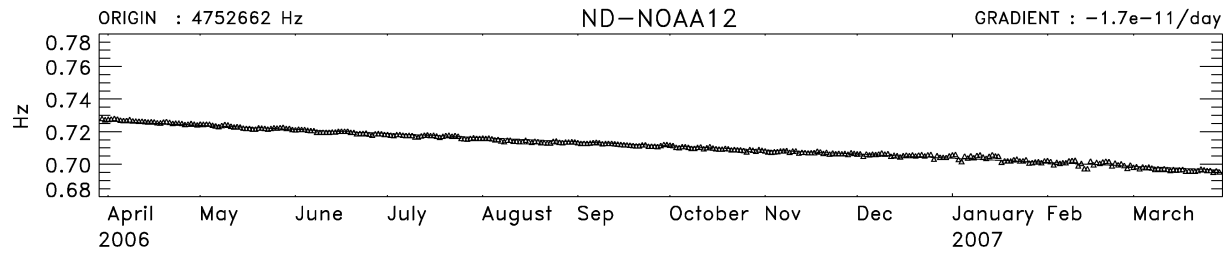
One of the major components of the instrument is the Ultra-Stable Oscillator and it is particularly monitored by CNES and by CLS since most of the instruments functions are referenced to this clock. More particularly, all time-tagging and frequency measurements depend highly on the oscillator stability.

As concerns the A-DCS instrument on METOP, the following figure presents the evolution of the frequency over the first month of activation of the redundant instrument which is now “operational”. One can see that after one month of functioning , the oscillator frequency begins to be well stabilized with a gradient about 0.001 Hz per day over 10 MHz, i.e 1.10^{-10} per day.



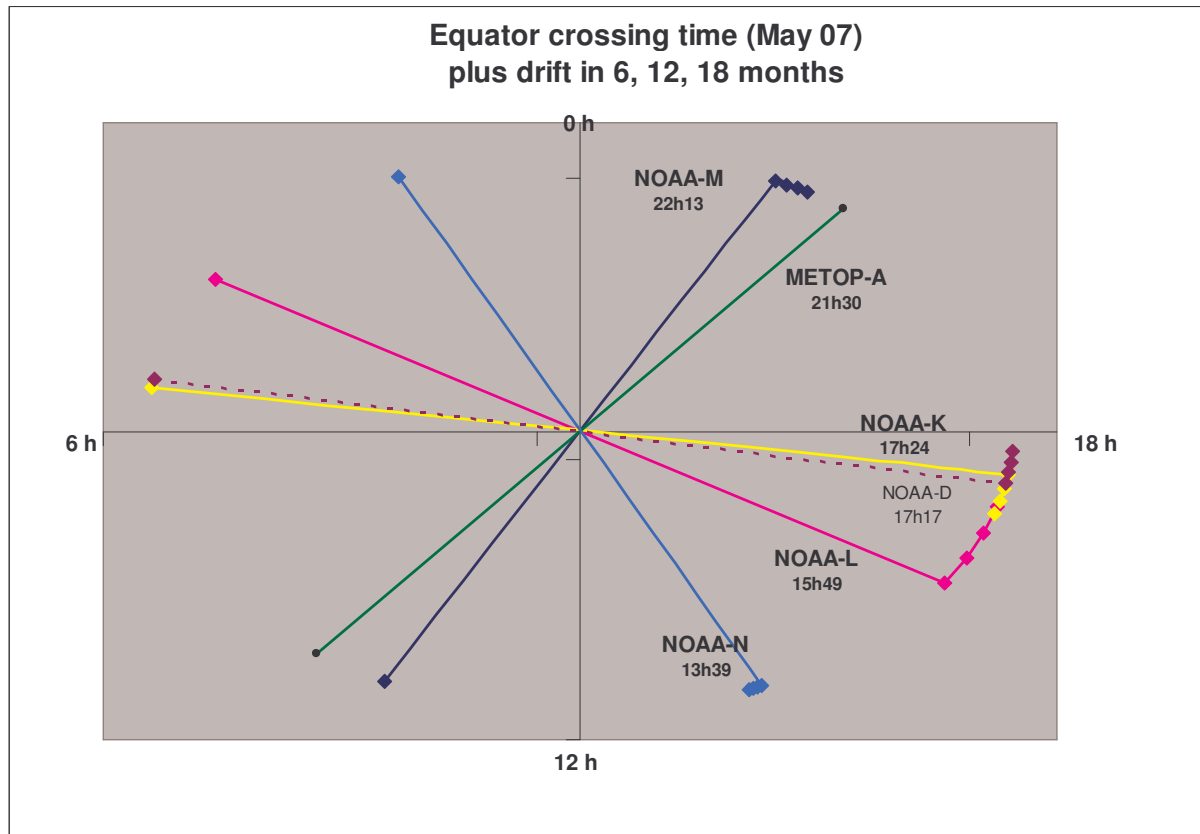
The figure of the next page provided by CLS presents the evolution of the frequency over 12 months for all the instruments on-board NOAA satellites. It shows that all the oscillators stay within their nominal range in term of stability (gradient around 1.10^{-11} per day).

Evolution of onboard USO frequency over 12 months



6- Orbital planes

The figure below shows the repartition of the orbital planes of the seven satellites as of May 2007.



Currently, with the 6 satellites, the repartition is optimal with a good repartition of the plans and the waiting time for any beacon on the surface of the earth is minimised.

Within 18 months, the NOAA-J satellite should be deactivated (after NOAA-K end of May 2007) and the Argos Service should be a bit degraded but should stay performing as far as the four NOAA satellites embarking the Argos-2 instruments are still operational.

End of 2009, the Argos constellation should be based on the three main orbits at 13h30, 17h30/18h00 and 21h30 with 3 Argos-3 instruments (Metop-A, NOAA-N' and SARAL), the other NOAA satellites embarking Argos-2 instruments ensuring a very good complement in term of performance and reliability.

Equator crossing time (end of 2009)

